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Soviet, U.S. Scientists Reach Seismic Agreement

An unprecedented agreement to establish seismic monitoring stations near the U.S. and Soviet test sites is aimed at moving the superpowers toward a comprehensive ban

IN a decision of substantial interest to U.S. seismologists, the Academy of Sciences of the U.S.S.R. has agreed to allow independent monitoring of seismic signals in the vicinity of the principal Soviet nuclear test site. The agreement, which was reached in Moscow in late May with representatives of the Natural Resources Defense Council (NRDC), a private environmental group, calls for the establishment of three seismic stations manned jointly by U.S. and Soviet scientists at different sites within 200 kilometers of Semipalatinsk, in south central Russia.

The stations, which are to be established within the next few months, will operate at least into autumn and probably longer, according to Thomas Cochran, a nuclear physicist who works for NRDC in Washington. In exchange, he said, a team of Soviet researchers will be invited to staff three similar seismic monitoring posts to be established near the U.S. nuclear test site in southern Nevada.

The principal goal is "to perfect seismic techniques" needed for verification of a nuclear testing moratorium or comprehensive ban, the agreement states. Bilateral negotiations on a test ban treaty were terminated by the Reagan Administration in 1982, in part because of concerns about verification but more importantly of the need for additional nuclear tests to modernize and expand the present U.S. arsenal, and to develop a defensive nuclear shield. The Soviet Union has pressed for their resumption.

Several weeks before the delegation from NRDC traveled to Moscow, senior Administration officials cautioned that the proposal might play into the Soviets' hands. They also asserted that data from the monitoring station would not resolve uncertainties in the United States about the yields of Soviet detonations, a point that NRDC did not dispute. The group decided to proceed anyway, Cochran says, in order to demonstrate that on-site monitoring in the Soviet Union poses no obstacle to a test ban treaty, and to obtain baseline seismic data for a verification network.

The arrangement is clearly unprecedent-

ed. Both countries agreed to test site inspection as a verification measure in a pair of treaties limiting nuclear test yields during the 1970's, but neither treaty has been ratified by the U.S. Senate, and the inspections were to have been of limited duration. The agreement is also novel in that the cost of the necessary equipment—including at least two sophisticated U.S. accelerometers and velocity meters at each site—will be shared by NRDC and the Soviet Academy, as will all travel expenses and construction costs. Contributions of money and scientific expertise from the U.S. government are wel-

A monitoring site in the Soviet Union "will definitely provide interesting information."

come but essentially irrelevant. (NRDC hopes to obtain \$500,000 in private financing before 18 June.)

The plan was hatched by Cochran in relative secrecy last January. After preliminary discussions with the Soviet embassy in Washington, he presented it to a delegation of visiting Soviet scientists in April, and finally to a scientific workshop in Moscow chaired by Yevgeniy Velikhov, the vice president of the Soviet Academy of Sciences. Seismologists from India and Sweden attended the workshop as observers. On 28 May, the agreement was signed by Velikhov and Adrian DeWind, a New York tax attorney who chairs the NRDC board.

The Soviets' principal motivation is apparently not scientific. Seismic experts consulted by *Science* said that Soviet scientists would probably gain little new information from the monitoring station in the United States, because seismic signals from locations nearer the Nevada test site are routinely recorded and published by the U.S. Geological Survey. U.S. scientists, in contrast, will probably learn a great deal from their site in the Soviet Union. The nearest exist-

ing U.S. seismic station is believed to be in China, more than 400 kilometers from Semipalatinsk, and there is a relative dearth of information in the west on seismic propagation in that region.

"It will definitely provide interesting information," says James Hannon, the program manager for seismic monitoring at Lawrence Livermore National Laboratory. "Everyone will be anxious to look at it." The data will reveal the regional characteristics of so-called high-frequency seismic waves, above 30 hertz or so, presently considered one of the most interesting topics of seismological research. They will also provide helpful clues to overall regional seismicity, earthquake mechanisms, and seismic wave propagation. As such, the data may help determine the number of monitoring stations needed to verify a comprehensive test ban, as well as the optimal design for each station and the optimal frequency at which seismic signals should be recorded, Hannon says.

Ironically, the existence of a related Soviet arms control effort—a unilateral test moratorium begun last August—will slightly diminish the value of the information gleaned from the monitoring experiment. Information about the local geology will perforce be drawn from signals generated by more distant events, including U.S. and French bomb tests. But Cochran stresses that "NRDC is not interested in the intelligence-gathering aspects of the experiment. Our primary goal is simply to demonstrate that Soviet and American scientists can work together and establish these stations in their respective countries." In any event, the experiment will probably continue beyond August, when the Soviet moratorium is expected to end, Cochran says. All of the collected data will be published openly, he adds.

Apparently, the only potential hitch is active Administration opposition. If it wanted to, the State Department could deny the Soviet research team the visas necessary for travel to the Southwest. But this would probably be too embarrassing, as the Soviets have promised to allow the American group in even if their own group is excluded. In addition, the Administration has already invited the Soviets to visit the Nevada test site itself, so travel to an area several hundred kilometers away can hardly be deemed sensitive. The Commerce Department could also prohibit the export of the appropriate seismic equipment to the Soviet Union. But NRDC deliberately plans to use off-the-shelf seismic equipment similar to that purchased by the Soviet Union in the past. "Nobody gave us any hope of pulling this off," Cochran says. "We are as surprised as anyone." ■ **R. JEFFREY SMITH**

LETTERS TO THE EDITOR

Why Continue Nuclear Testing?

Three members of the President's Commission on Strategic Forces—Brent Scowcroft, John Deutch and James Woolsey—have decided that a Comprehensive Test Ban is not a good idea ["Nukes: Continue the Tests," June 29]. I take issue with them.

They argue that neither Star Wars nor CTB will make nuclear weapons "obsolete," but it is only Star Wars proponents who have made this claim. CTB advocates say only that it will slow modernization and cut off one important tool in the arms race. The writers say that continued testing will allow for safer nuclear warheads to be developed, warheads whose conventional "triggers" will be harder for terrorists to set off. There is currently no reason why safeguards of this sort cannot be tested without setting off the nuclear charge, and a number of weapons engineers have testified to that effect.

They argue that low-yield warheads need to be tested so these can be fitted on more accurate missiles, which is said

to "contribute to strategic stability." It is these super-accurate missiles that are used on both sides to threaten each other's nuclear forces. This kind of development leads to the classic "use them or lose them" trap, which does not lead to strategic stability.

They fall back on the old argument that we need to test to make sure our missiles are reliable. There are two weaknesses in that. First, to whatever limited extent there is validity to the reliability argument, that applies to both sides. If there is uncertainty on both sides as to reliability, I consider that positive, because no one will launch a first strike unless they're sure everything will work perfectly.

The other weakness is that less than 5 percent of our tests have been for reliability checks. The best way to monitor reliability is by dismantling sample weapons and conducting non-nuclear testing of key components. They further state that we rely more on quality than quantity, a surprising argument in light

of our larger strategic warhead arsenal. But our significant qualitative lead would be frozen in place were a CTB negotiated, so their position is doubly confusing.

In 1978 I was one of the delegates to the U.N. Special Session on Disarmament. At that time there were no significant problems in verifying underground tests by the Soviets if we could place in-country seismic sensors in both countries. Our technology has improved considerably since 1978. Verification is not an issue. Any reasonably objective observer has to come to that conclusion.

The authors agree with the administration that a CTB would not help our nonproliferation efforts. I disagree. Nuclear arms races can be averted if all states agree to forgo any testing. With so much at stake for everyone, enforcement of a "no-test-anywhere" regime could be achieved if both the United States and the Soviet Union were on the same side of the fence. They would be united in their determination to police a test ban.

A Comprehensive Test Ban Treaty is in our interest. When the Soviets offer to stop all testing for a specified period—the latest until Aug. 6—we should accept and say that we will both refrain from testing while we resume negotiations for a comprehensive treaty. The United States should be the leader in arms control, not the leader in the arms race.

PAUL SIMON
U.S. Senator (D-Ill.)
Washington

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Brent Scowcroft, John M. Deutch and R. James Woolsey

Nukes: Continue the Tests

The Soviets have recently made a new strategic arms control proposal at Geneva, and they have also continued to press the United States to agree to a Comprehensive Test Ban—that is, a prohibition on any underground tests of nuclear weapons. The administration has stated that it is examining the arms control proposal but has rejected the CTB.

Some who advocate a CTB maintain that a ban on testing would generally lower the reliability of nuclear weapons and thus advance the cause of peace by making all such weapons less usable. Other CTB advocates believe the contrary—that testing is not really needed to ensure weapon effectiveness. Still others see a CTB as important chiefly as a symbolic step toward the eventual abolition of all nuclear weapons.

Not only do these arguments in part contradict each other, but none holds much water. The hard truth is that for the foreseeable future the stability of the strategic balance and the security of this nation and the West will depend upon the deterrence provided by nuclear weapons. Neither good intentions nor a single technical fix (whether it be a CTB or, for that matter, deployment of space-based ballistic missile defense) will lead to nuclear weapons' becoming obsolete within any relevant time frame.

That day, if it ever comes, can only be brought about by Western strength and by the Soviets' gradual acceptance that the perpetual expansion of their power is a hopeless goal. Today, however, nuclear weapons reflect the political chasm between freedom and totalitarianism. As long as this political competition exists, a strong military posture will be required to deter Soviet aggression and expansionism. In particular, although we may be able to reduce our degree of reliance on nuclear weapons and improve their safety—and although we may hope for reasonable arms control and subdued rhetoric—such weapons will be required for an indefinite period to preserve the peace. Our allies appreciate the contribution Western nuclear weapons make to peace and stability today, perhaps better than we do.

In light of this, it would be a serious mistake for the United States to abandon nuclear testing now. First, limited testing permits the development of weapons that are far less sensitive to the explosion of their conventional explosive components as a result of a terrorist incident or an accident. Even if the actual conventional detonation of a nuclear weapon is highly unlikely

in such cases, the resultant scattering of nuclear material would be devastating.

Second, testing is required to replace high-yield weapons with new lower-yield ones—a change made possible by the more accurate delivery systems of today. These sorts of modernization of nuclear weapons contribute to strategic stability.

Finally, experts from the U.S. nuclear weapons laboratories largely agree that, over time, some testing is required to ensure reliability of the nuclear stockpile. Lack of confidence in the stockpile would impair our ability to rely on nuclear weapons for deterrence. And reduced confidence in reliability under a CTB might well be of greater disadvantage to the United States than to the Soviets. With our greater reliance on quality than on quantity, our confidence in our weapons might well deteriorate much faster than the Soviets' confidence in theirs.

Moreover, there is substantial debate about how to verify a CTB treaty. A threshold about one-tenth of the current 150-kiloton limit could probably be verified adequately with seismic stations outside the adversary's territory. An even lower

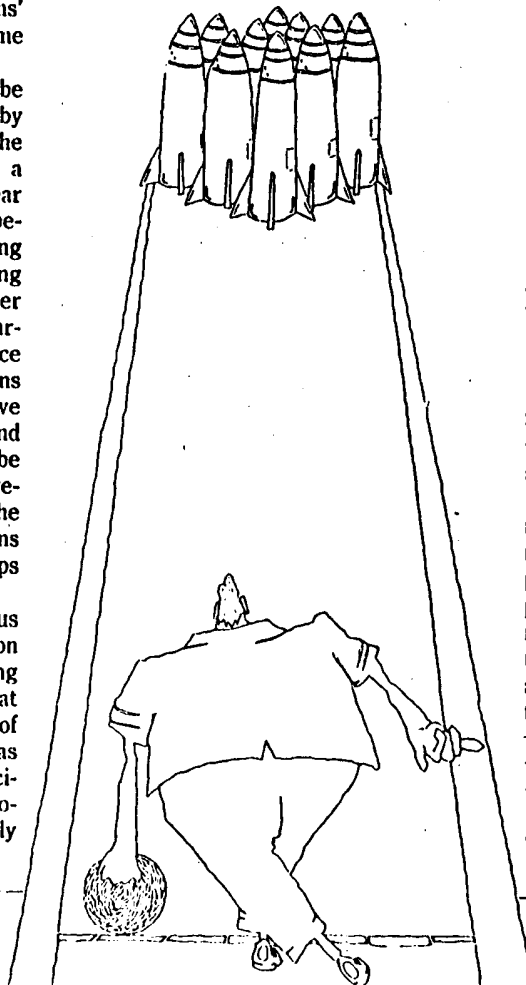
threshold could be verified with cooperative measures that permitted each nation to have seismic stations in the other. But some cheating is possible at the level of very small nuclear detonations. Moreover, at these very low levels the borderline between nuclear tests and directed energy experiments becomes difficult to define. The inevitable political debate over verification of a CTB would add little to our understanding or to strategic stability.

The argument is often advanced that a CTB will slow the spread of nuclear weapons to other nations. It is true that American and Soviet nuclear testing provides for nonnuclear states a convenient political rationalization for pursuing nuclear weapons development. But the reasons that lead a state to acquire nuclear weapons are fundamentally grounded in that state's perception of its own security interests, not in the behavior of the United States or the Soviet Union. South Africa today, for example, is unlikely to avoid nuclear weapons development because of a U.S.-Soviet CTB. Adherence by the superpowers to a CTB will change the rhetoric of some nations about nonproliferation but will have at best a marginal impact on the reality of what they do.

A reasonable policy for this nation to follow would be, first, to ratify the Threshold Test Ban Treaty signed by the United States and the Soviet Union in 1974. Following that, the United States and the Soviets could enter into negotiations to lower this limit to a level consistent with each country's technical requirements and its ability to verify, with high confidence, compliance with the lowered threshold. This would exert a long-term pressure toward lower yields and less reliance on nuclear weapons without the attendant problems described above. Finally, both the Soviets and the United States should renounce the use of nuclear explosives for so-called peaceful uses.

This set of proposals will fully please neither side in our current domestic debate nor does it comport with the current Soviet proposal. But it offers a reasonable approach toward dealing with this difficult issue while we devote principal attention to the main show—maintaining a deterrent and pursuing stabilizing strategic arms limitation agreements.

Brent Scowcroft is chairman and John Deutch and R. James Woolsey are members of the President's Commission on Strategic Forces.



BY MATTHEW FINCH / BULLETIN OF THE ATOMIC SCIENTISTS

SUPPLEMENTAL CLIPS: MONDAY, 14 JULY 1986

NEW YORK TIMES 13 JULY 1985 Pg. 2E

Untying the Knot of Nuclear Test Verification

By MICHAEL R. GORDON

THE United States and the Soviet Union have been engaged for five years in two monologues on the verification of underground testing of nuclear weapons.

The United States has proposed discussions on ways to improve the verification of compliance with two treaties that limit the size of underground nuclear explosions, saying that it will not ratify the treaties, which it signed in the 1970's, unless Moscow agrees to such improvements. The United States has also opposed renewing negotiations on a comprehensive ban on testing.

The Soviet Union has taken a contrary stance: it has refused to discuss these verification issues until the United States ratifies the treaties. And Moscow has pushed for a cessation of testing and stressed its willingness to allow on-site inspection of a ban on tests. The debate has gone round and round, with neither side agreeing how to discuss the other side's concerns about verification. But that situation has now changed.

According to a recent understanding worked out by the two sides, American and Soviet Government experts are to meet for a general discussion of verification issues in which each side will be free to raise its concerns. No date or place for the session has yet been established, but it could occur this summer.

None of this necessarily means that the basic objectives of the two sides have changed. But some Administration officials hope that the meeting of experts would lay the basis for subsequent negotiations in which the Soviet Union would agree to some additional verification measures pertaining to the 1970's treaties on testing and the United States would then move to ratify the agreements. The two treaties in question are the Threshold Test Ban Treaty of 1974, which limits underground tests of nuclear weapons to 150 kilotons, and the 1976 treaty, which extends this limit to peaceful nuclear explosions.

The United States has monitored Soviet explosions covered by those treaties with devices, stationed outside Soviet territory, that pick up seismic data. Experts note that the geology of the United States and Soviet test sites differs substantially, and this has complicated seismic measurements of Soviet tests. As a result, the Reagan

Administration has argued that it needs direct measurements of some Soviet tests to establish more reliably the accuracy of the data.

According to the Administration's plan, the measurements would be taken by using a cable inserted into the ground where the explosion takes place. The detonation would emit a shock wave that would crush the cable. Data showing how quickly the cable was destroyed would enable experts to estimate the size of the shock wave and, by extrapolation, the size of the explosion.

In the view of some officials, a compromise permitting additional verification measures would be important for three reasons. First, it would have a positive political effect on United States-Soviet relations. The two treaties were negotiated in the heyday of détente, and their ratification would be a demonstration that the Administration values some arms control agreements, even though it has taken a hard line on arms control, having repudiated the second strategic arms treaty of 1979 and raised questions about its commitment to the anti-ballistic missile treaty of 1972. Second, a compromise on verification could be taken as a sign that the Soviet Union is prepared to consider American concerns that Moscow has violated arms control agreements.

The Administration has charged that the Soviet Union may have violated the limit of the Threshold Test Ban Treaty. Doubt has been cast on that allegation by the Central Intelligence Agency's decision to change its method of assessing the yields of such tests. The new method lowers estimates of the size of the tests, suggesting that the old figures were too high and that the degree of Russian cheating might have been exaggerated in Washington.

But a Soviet decision to allow additional verification measures could put the issue completely to rest. A third important spinoff from such a compromise is that it could stand as a precedent for on-site verification measures for other arms control agreements. Whether such a deal can be worked out is unclear, and it will require some give on both sides.

The Soviet Union would have to resist its traditional penchant for secrecy. The Reagan Administration, for its part, would have to resist the temptation to make politically unrealistic demands of the Russians on the issue of verification. Further, the Administration might have to make some sort of other arms control concession in return for improved verification procedures.

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U.S. GROUP CHECKS SOVIET ATOM SITE

By WILLIAM J. BROAD

Special to The New York Times

KARKARALINSK, Kazakhstan, U.S.S.R., July 13 — In this remote region of Central Asia, usually off limits to foreigners, a team of Western scientists has set up an array of sensitive instruments to monitor the main underground site where the Soviet Union explodes its nuclear weapons.

The equipment they ~~acquired~~ this weekend has already begun to detect earth tremors such as an earthquake that broke windows in southern California today. [Page A8.] The scientists say it will enable them to monitor a moratorium on underground testing that the Soviet Union began last Aug. 6 and extended, despite the refusal of the United States to join, until this Aug. 6.

Group Favors Test Ban

The scientists, the first from the West allowed here, are affiliated with the Natural Resources Defense Council, which is seeking to show that a ban on underground nuclear tests can be policed.

They hope to monitor and identify all tremors in the region, distinguishing between earthquakes, industrial explosions, mining operations and the detonation of nuclear weapons.

Even without such tests, the scientists say, the equipment will provide enough information about the geology of the test site to enable scientists elsewhere to better gauge the size of future Soviet tests.

Most of the rock in this region is granite, which transmits shock waves well and makes bomb blasts sound "louder" to seismologists than do those of the same size at the American nuclear test site in Nevada. The rock there is mainly volcanic, a poor medium for such transmission.

The American scientists here hope to "listen" to an American nuclear test scheduled for next Thursday to learn how shock waves are transmitted through this area. Later, other scientists who know the exact size of the American tests will be able to use the information gathered here to calibrate seismic measurements made in Nevada of Soviet tests.

The scientists have set up the first of three seismic stations behind a miners' resort in this small town about 100 miles southwest of the main Soviet test near Semipalatinsk and 1,700 miles southeast of Moscow.

Signal to Digital Recorder

One seismometer, about the size of a small television set, sits on a rock slab at the base of a towering rock bluff,

sending its signal over 50 feet of wire to a nearby digital recorder. The units are separated so that technicians who maintain the recorder and change its magnetic tapes are far enough from the seismometer to leave it undisturbed by their movements.

Any vibration in the earth causes the casing of the seismometer to move, while a heavy mass inside, which is supported by springs, tends to remain at rest. The relative motion between the casing and weight is measured electrically, providing a measure of the earth's motion.

In a calibration test on Friday, this seismometer recorded a sharp signal that looked "like a small earthquake," said Dr. James N. Brune, a geophysicist from the University of California at San Diego. The time between the shock waves generated by the "event" indicated that it was about 125 miles away, Dr. Brune said.

Three Stations Are Planned

In the next few weeks, the team here is planning to set up two other seismic stations around the edge of the nuclear test site. One will be near Bayanaul, north of here, and the other near Semipalatinsk, the test center, to the east. In a process called triangulation, the three stations will help identify the direction from which seismic signals emanate, according to Dr. Brune. Any signals from the center of the triangle, he said, will have their origin at the nuclear test site.

The formal agreement signed by the council and the Soviet Union does not specify how long the project is to last but it is understood, informally, that the test phase will last for a year. The scientists have begun work on equipment to supplement or possibly replace the devices now in place with larger and more sensitive seismic sensors.

This second phase, scheduled to be completed this fall, involves installation of seismometers at the bottom of holes about 325 feet deep that have been drilled through solid rock. Such "down hole" seismometers are about 100 times more sensitive than surface ones because the reduction of noise from wind and man-made sources increases the chance of detecting slight tremors from deep within the earth. The project also entails building shelters for computerized recorders and setting up a laboratory where the seismic data will be analyzed.

"This is perfect," said Dr. Charles B. Archambeau, a seismologist from the University of Colorado, as he walked across a rocky, treeless depression while searching for a site for a down hole seismometer.

Dr. Archambeau, who is chairman of the council's technical advisory committee for this project, praised the site because "it's sheltered, and there's not a lot of wind." The down-hole plan, as with the surface one, is to set up three widely separated stations.

But the scientists said they believed the next phase might tax the limits of Soviet cooperation.

"I'm surprised as anybody that they

let us in," said Dr. Jon Berger, a geophysicist from the University of California at San Diego and one of nine American scientists here. "And I still have reservations. The real test will be if they let us set up the down hole equipment and run it for a year."

The council, which is based in New York, sponsored the project after forging an unusual accord with the Soviet Academy of Sciences. But the Reagan Administration opposes a ban on nuclear testing, saying such explosions are needed to maintain the reliability of old weapons and to develop new ones. The Administration also says a ban would be impossible to police, an assertion that the council and the scientists here dispute.

An unresolved question in this second phase of the operation is whether the United States will allow the export of highly sophisticated equipment, especially the computers needed to record and analyze the seismic data. United States policy is to restrict the flow of such devices to the Soviet Union.

One reason Washington may lend its support to the plan, however, is that it has wanted a detailed seismic charting of this region for decades.

Referring to the different geological characteristics of the Soviet and American test sites, Dr. Berger said: "It's like you're looking at something through a distorted lens. You need to know the extent of the distortion."

All data collected here are to be made available to both Soviet and American scientists. The team's work here is being aided by six Soviet seismologists from the Institute of the Physics of the Earth, an arm of the Soviet Academy of Sciences.

Soviet Support Is Uncertain

Soviet support for all aspects of the project is also uncertain.

The plan is for Soviet scientists to eventually set up a similar seismic array near the nuclear test site in the Nevada desert. But what the Soviet Government stands to gain in all this is more political than technical, since such seismic data are already publicly available in the United States.

The equipment would be set up on private land in an arrangement that would not require approval by the United States Government.

Dr. Thomas B. Cochran, the senior American scientist here, said the American visit was opposed by the Soviet military, which runs the nuclear test site near Semipalatinsk and wants to limit technical aspects of the council's plan.

Dr. Cochran, the director of the seismic project, said the Soviet military was lobbying for the seismic stations to be switched off during any Soviet nuclear tests, if they were resumed.

In addition to Dr. Archambeau, Dr. Berger, Dr. Brune and Dr. Cochran, the other American scientists here are Paul Bodin and David Carrel of the University of California at San Diego, Dr. Kleth Priestly of the University of Nevada and Dr. Brian Tucker and Dr. Marie-Jose Fremont, who are private seismic consultants.

U.S. Monitors Put at Soviet Nuclear Site

*Use in Actual Test
Still Not Assured*

Associated Press

MOSCOW, July 13—American scientists installed the first western monitoring station at a Soviet nuclear test site, placing about a dozen seismic devices in rugged hill country of remote Kazakhstan, a member of the group said today.

It is the first time western scientists have been allowed near the Soviet site or permitted to set up a station in Soviet territory.

Thomas Cochran from the Washington-based Natural Resource Defense Council said his group received strong Soviet support for the project, which he hopes will show it is possible to set up stations for monitoring a nuclear test ban.

But he said the U.S. scientists have no assurance that they will be allowed to monitor any nuclear tests from the three stations once Kremlin chief Mikhail Gorbachev's unilateral moratorium expires Aug. 6.

"We will certainly be allowed to stay there after Aug. 6," he said. "We'll have to see if we'll be allowed to record their tests or not. Either way, we'd know that a test occurred. What would be lost if we're not allowed to monitor a test would be additional interesting technical information that could be useful in further calibrating the site."

The Soviet test site is about 1,800 miles southeast of Moscow near the Kazakhstan city of Semipalatinsk. The project, conducted under an agreement signed May 28 by the nonprofit council and the Soviet Academy of Sciences, calls for Soviet scientists to install their own seismic monitoring stations near the U.S. testing site in Nevada.

Council chairman Adrian DeWind said the Soviet government gave its blessing to the project and that the State Department "has told us visas will be issued for the Soviet scientists to come to the United States."

The seismic stations are above-ground, Cochran said, making them susceptible to interference from wind and movement of nearby trees. The scientists plan to import more sensitive equipment.